

# PVsyst - Simulation report

## Grid-Connected System

Project: Bank Albilad-Parking

Variant: Bank Albilad tower-25 years

No 3D scene defined, no shadings

System power: 51.0 kWp

Al Mu'tamarāt - Saudi Arabia



# Project: Bank Albilad-Parking

## Variant: Bank Albilad tower-25 years

### PVsyst V7.4.8

VC4, Simulation date:  
11/13/24 23:19  
with V7.4.8

### Project summary

#### Geographical Site

**Al Mu'tamarāt**  
Saudi Arabia

#### Situation

Latitude 24.68 °N  
Longitude 46.69 °E  
Altitude 602 m  
Time zone UTC+3

#### Project settings

Albedo 0.20

#### Weather data

Al Mu'tamarāt  
Meteonorm 8.1 (1998-2002), Sat=28% - Synthetic

### System summary

#### Grid-Connected System

Simulation for year no 1

#### No 3D scene defined, no shadings

#### PV Field Orientation

Fixed planes 2 orientations  
Tilts/azimuths 5 / 62 °  
5 / 29 °

#### Near Shadings

No Shadings

#### User's needs

Unlimited load (grid)

#### System information

##### PV Array

Nb. of modules 85 units  
Pnom total 51.0 kWp

##### Inverters

Nb. of units 1 unit  
Pnom total 40.0 kWac  
Pnom ratio 1.275

### Results summary

Produced Energy 97057 kWh/year Specific production 1903 kWh/kWp/year Perf. Ratio PR 82.90 %

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**General parameters**

**Grid-Connected System**

No 3D scene defined, no shadings

**PV Field Orientation**

**Orientation**

Fixed planes 2 orientations  
Tilts/azimuths 5 / 62 °  
5 / 29 °

**Sheds configuration**

No 3D scene defined

**Models used**

Transposition Perez  
Diffuse Perez, Meteonorm  
Circumsolar separate

**Horizon**

Free Horizon

**Near Shadings**

No Shadings

**User's needs**

Unlimited load (grid)

**PV Array Characteristics**

**PV module**

Manufacturer Astronergy  
Model CHSM66RN(DG)F-BH-600

(Custom parameters definition)

Unit Nom. Power 600 Wp  
Number of PV modules 85 units  
Nominal (STC) 51.0 kWp

**Inverter**

Manufacturer Huawei Technologies  
Model SUN2000-40KTL-M3-400V

(Original PVsyst database)

Unit Nom. Power 40.0 kWac  
Number of inverters 1 unit  
Total power 40.0 kWac

**Array #1 - PV Array**

Orientation #1  
Tilt/Azimuth 5/62 °  
Number of PV modules 30 units  
Nominal (STC) 18.00 kWp  
Modules 2 string x 15 In series

Number of inverters 1 \* MPPT 41% 0.4 unit  
Total power 16.4 kWac

**At operating cond. (50°C)**

Pmpp 16.77 kWp  
U mpp 557 V  
I mpp 30 A

Operating voltage 200-1000 V  
Max. power (=>40°C) 44.0 kWac  
Pnom ratio (DC:AC) 1.10

**Array #2 - Sub-array #2**

Orientation #1  
Tilt/Azimuth 5/62 °  
Number of PV modules 14 units  
Nominal (STC) 8.40 kWp  
Modules 1 strings x 14 In series

Number of inverters 1 \* MPPT 15% 0.1 unit  
Total power 6.0 kWac

**At operating cond. (50°C)**

Pmpp 7.82 kWp  
U mpp 520 V  
I mpp 15 A

Operating voltage 200-1000 V  
Max. power (=>40°C) 44.0 kWac  
Pnom ratio (DC:AC) 1.40

**Array #3 - Sub-array #3**

Orientation #2  
Tilt/Azimuth 5/29 °  
Number of PV modules 26 units  
Nominal (STC) 15.60 kWp  
Modules 2 string x 13 In series

Number of inverters 1 \* MPPT 28% 0.3 unit  
Total power 11.1 kWac

**At operating cond. (50°C)**

Pmpp 14.53 kWp  
U mpp 483 V  
I mpp 30 A

Operating voltage 200-1000 V  
Max. power (=>40°C) 44.0 kWac  
Pnom ratio (DC:AC) 1.40



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### PV Array Characteristics

#### Array #4 - Sub-array #4

Orientation	#2		
Tilt/Azimuth	5/29 °		
Number of PV modules	15 units	Number of inverters	1 * MPPT 16% 0.2 unit
Nominal (STC)	9.00 kWp	Total power	6.4 kWac
Modules	1 strings x 15 In series		
<b>At operating cond. (50°C)</b>			
Pmpp	8.38 kWp	Operating voltage	200-1000 V
U mpp	557 V	Max. power (=>40°C)	44.0 kWac
I mpp	15 A	Pnom ratio (DC:AC)	1.40
<b>Total PV power</b>		<b>Total inverter power</b>	
Nominal (STC)	51 kWp	Total power	40 kWac
Total	85 modules	Number of inverters	1 unit
Module area	230 m²	Pnom ratio	1.27
		Power sharing defined	

### Array losses

#### Array Soiling Losses

Loss Fraction 4.0 %

#### Thermal Loss factor

Module temperature according to irradiance  
Uc (const) 29.0 W/m²K  
Uv (wind) 0.0 W/m²K/m/s

#### LID - Light Induced Degradation

Loss Fraction 0.6 %

#### Module Quality Loss

Loss Fraction 0.0 %

#### Module average degradation

Year no 1  
Loss factor 0.4 %/year

#### Mismatch due to degradation

Imp RMS dispersion 0.4 %/year  
Vmp RMS dispersion 0.4 %/year

#### Module mismatch losses

##### Array #1 - PV Array

Loss Fraction 1.0 % at MPP

##### Array #2 - Sub-array #2

Loss Fraction 1.0 % at MPP

##### Array #3 - Sub-array #3

Loss Fraction 1.0 % at MPP

##### Array #4 - Sub-array #4

Loss Fraction 1.0 % at MPP

#### IAM loss factor

Incidence effect (IAM): User defined profile

0°	40°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	1.000	0.984	0.949	0.830	0.000



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**DC wiring losses**

Global wiring resistance 10 mΩ  
Loss Fraction 1.0 % at STC

**Array #1 - PV Array**

Global array res. 201 mΩ  
Loss Fraction 1.0 % at STC

**Array #3 - Sub-array #3**

Global array res. 174 mΩ  
Loss Fraction 1.0 % at STC

**Array #2 - Sub-array #2**

Global array res. 375 mΩ  
Loss Fraction 1.0 % at STC

**Array #4 - Sub-array #4**

Global array res. 402 mΩ  
Loss Fraction 1.0 % at STC

**System losses**

**Unavailability of the system**

Time fraction 2.0 %  
7.3 days,  
3 periods



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### Main results

#### System Production

Produced Energy

97057 kWh/year

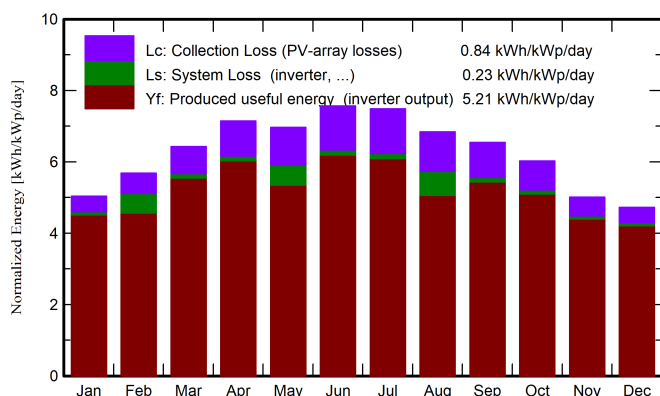
Specific production

1903 kWh/kWp/year

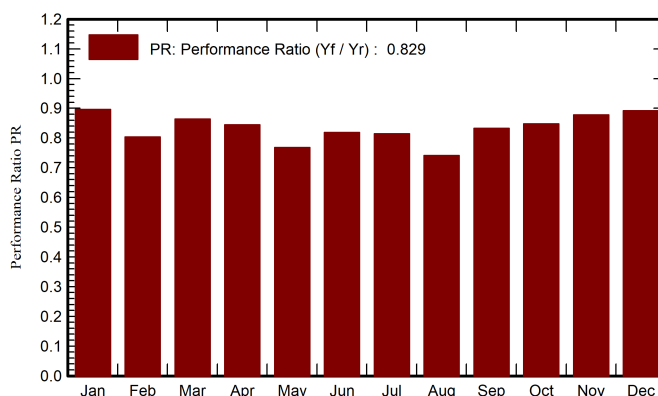
Perf. Ratio PR

82.90 %

#### Normalized productions (per installed kWp)



#### Performance Ratio PR



### Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	ratio
January	147.0	26.14	14.73	156.2	149.6	7288	7144	0.897
February	153.0	50.40	18.07	159.1	152.5	7310	6526	0.804
March	194.2	63.21	22.88	199.2	191.0	8972	8778	0.864
April	211.9	77.10	27.71	214.3	205.3	9432	9225	0.844
May	216.1	88.68	34.20	216.1	207.1	9354	8460	0.768
June	227.9	91.31	36.27	227.0	217.6	9700	9481	0.819
July	232.7	82.07	37.84	232.1	222.6	9864	9642	0.814
August	210.9	87.33	37.99	212.0	203.1	9072	8010	0.741
September	192.8	61.77	34.13	196.2	188.0	8519	8331	0.832
October	179.8	42.06	29.52	186.6	178.8	8249	8070	0.848
November	141.8	35.35	21.33	150.3	144.0	6866	6726	0.878
December	136.8	26.83	16.58	146.4	140.2	6798	6664	0.892
Year	2245.0	732.25	27.66	2295.7	2200.0	101424	97057	0.829

#### Legends

GlobHor Global horizontal irradiation

DiffHor Horizontal diffuse irradiation

T\_Amb Ambient Temperature

GlobInc Global incident in coll. plane

GlobEff Effective Global, corr. for IAM and shadings

EArray Effective energy at the output of the array

E\_Grid Energy injected into grid

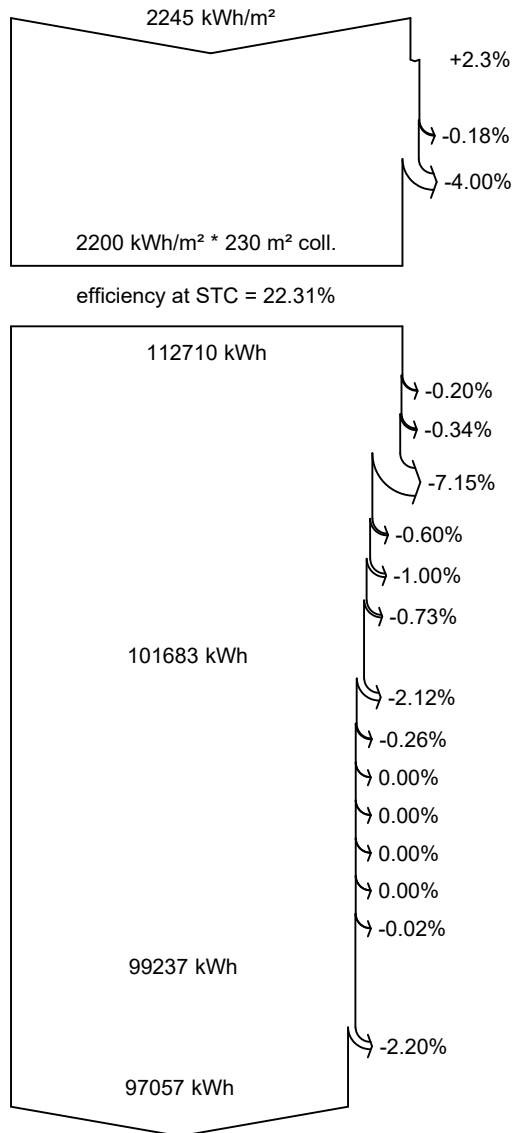
PR Performance Ratio



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**Loss diagram**



**Global horizontal irradiation**

**Global incident in coll. plane**

IAM factor on global

Soiling loss factor

**Effective irradiation on collectors**

PV conversion

**Array nominal energy (at STC effic.)**

Module Degradation Loss ( for year #1)

PV loss due to irradiance level

PV loss due to temperature

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

**Array virtual energy at MPP**

Inverter Loss during operation (efficiency)

Inverter Loss over nominal inv. power

Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

Night consumption

**Available Energy at Inverter Output**

System unavailability

**Energy injected into grid**

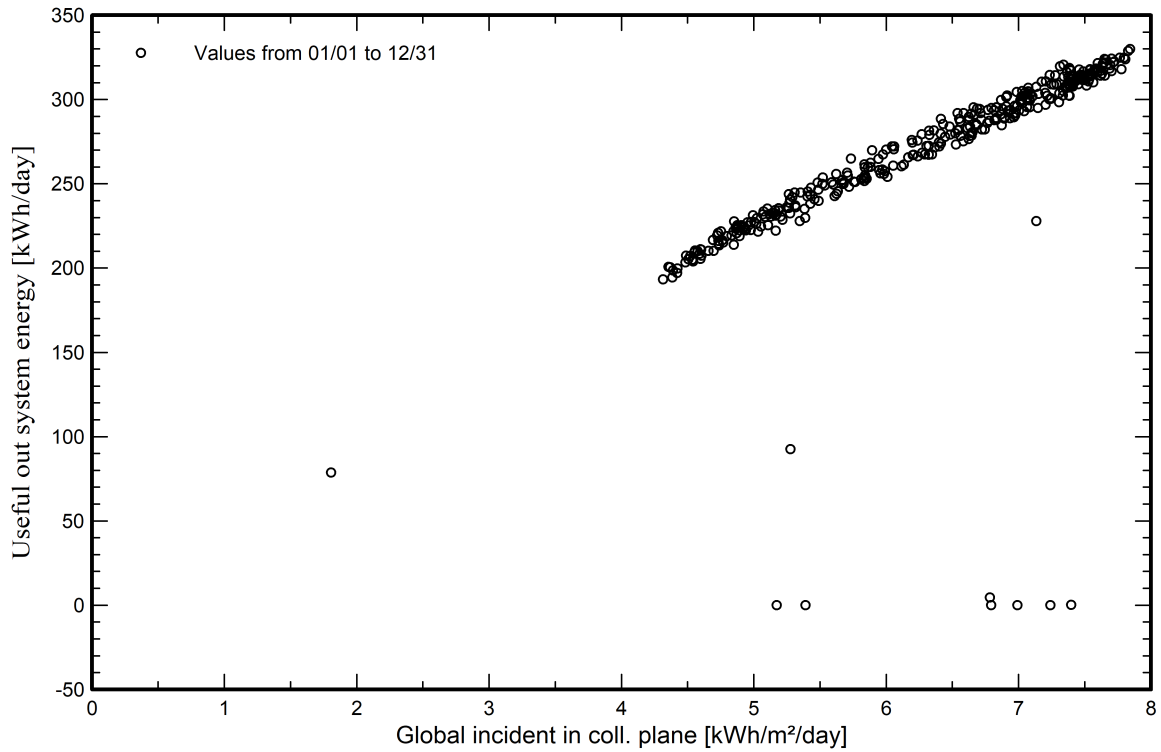


**PVsyst V7.4.8**

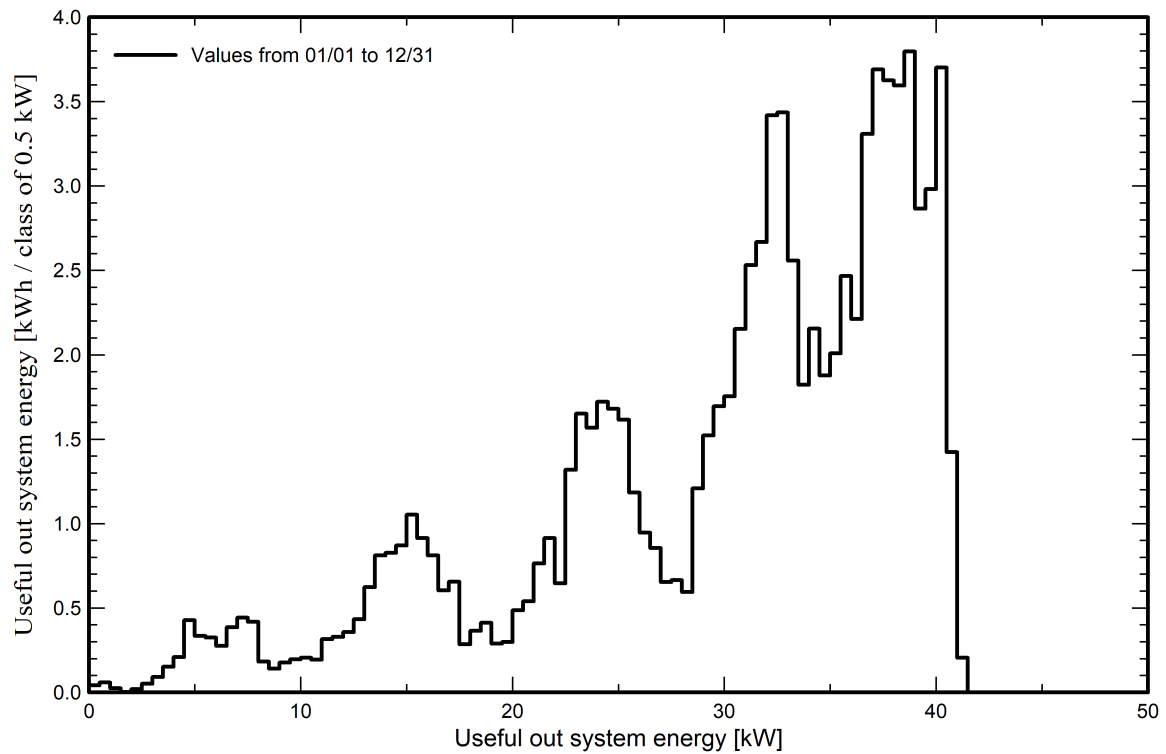
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**Predef. graphs**

**Daily Input/Output diagram**



**System Output Power Distribution**







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### Aging Tool

#### Aging Parameters

Time span of simulation 25 years

#### Module average degradation

Loss factor 0.4 %/year

#### Mismatch due to degradation

Imp RMS dispersion 0.4 %/year

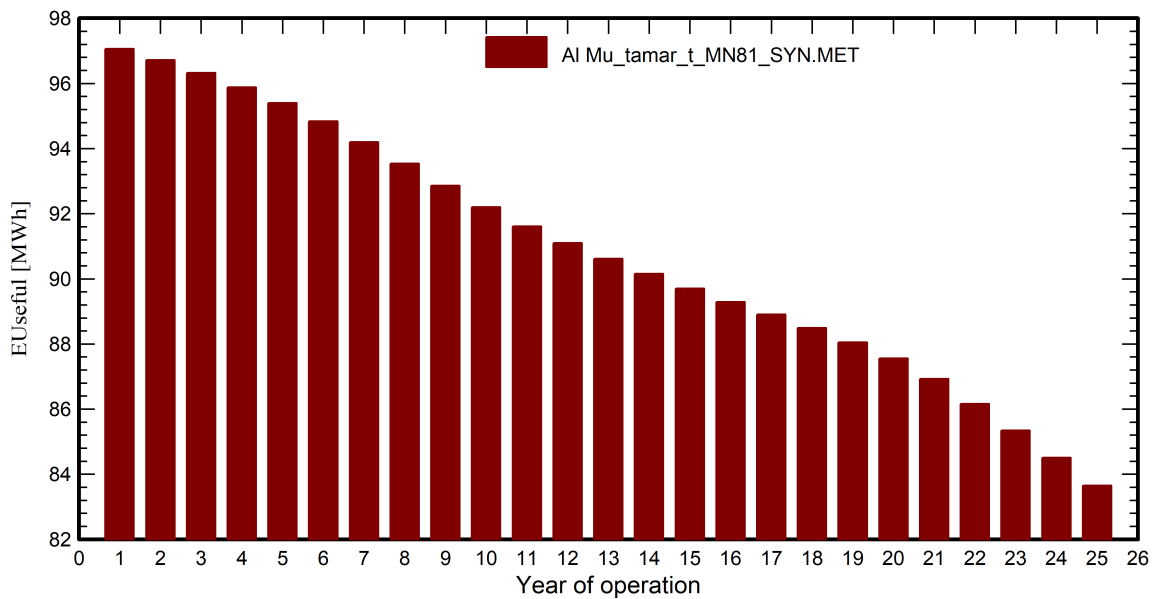
Vmp RMS dispersion 0.4 %/year

#### Weather data used in the simulation

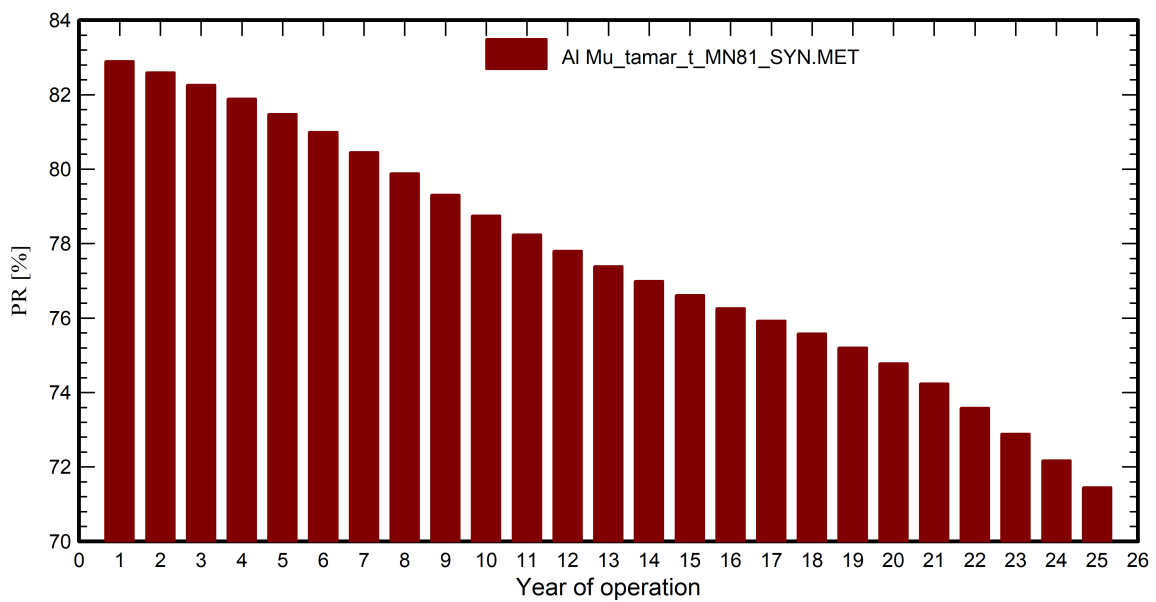
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Years reference year

#### Useful out system energy



#### Performance Ratio





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**Aging Tool**

**Aging Parameters**

Time span of simulation 25 years

**Module average degradation**

Loss factor 0.4 %/year

**Mismatch due to degradation**

Imp RMS dispersion 0.4 %/year

Vmp RMS dispersion 0.4 %/year

**Weather data used in the simulation**

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Years reference year

	<b>EUseful</b>	<b>PR</b>	<b>PR loss</b>
<b>Year</b>	<b>MWh</b>	<b>%</b>	<b>%</b>
1	97.06	82.90	-0.18
2	96.71	82.60	-0.53
3	96.32	82.27	-0.94
4	95.88	81.89	-1.39
5	95.40	81.48	-1.89
6	94.83	81.00	-2.47
7	94.19	80.45	-3.12
8	93.53	79.89	-3.80
9	92.86	79.31	-4.49
10	92.20	78.75	-5.17
11	91.61	78.25	-5.78
12	91.10	77.81	-6.31
13	90.61	77.39	-6.81
14	90.15	77.00	-7.28
15	89.70	76.62	-7.74
16	89.29	76.26	-8.17
17	88.90	75.93	-8.57
18	88.49	75.58	-8.99
19	88.05	75.20	-9.44
20	87.55	74.78	-9.95
21	86.92	74.24	-10.60
22	86.16	73.59	-11.39
23	85.34	72.89	-12.22
24	84.50	72.18	-13.09
25	83.65	71.45	-13.96



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**P50 - P90 evaluation**

**Weather data**

Source Meteoronorm 8.1 (1998-2002), Sat=28%  
Kind TMY, multi-year  
Year-to-year variability(Variance) 3.0 %  
**Specified Deviation**  
Climate change 0.0 %

**Global variability (weather data + system)**

Variability (Quadratic sum) 3.5 %

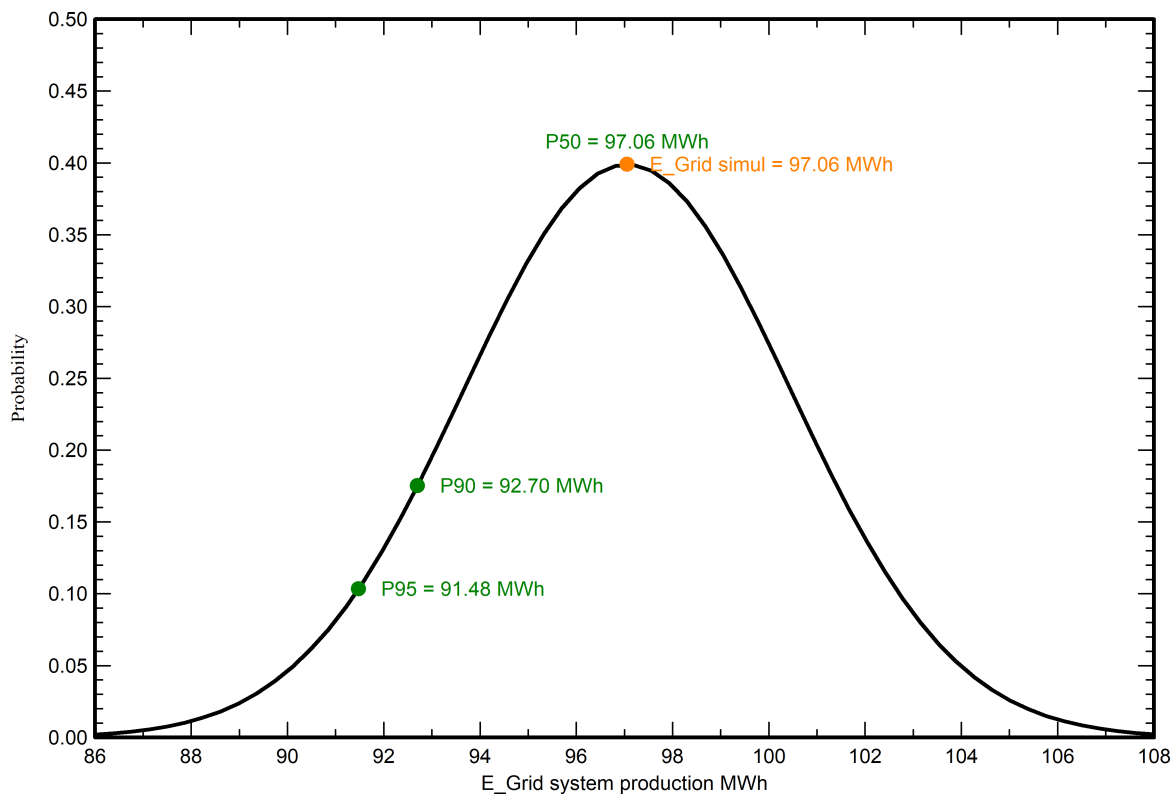
**Simulation and parameters uncertainties**

PV module modelling/parameters 1.0 %  
Inverter efficiency uncertainty 0.5 %  
Soiling and mismatch uncertainties 1.0 %  
Degradation uncertainty 1.0 %

**Annual production probability**

Variability 3.40 MWh  
P50 97.06 MWh  
P90 92.70 MWh  
P95 91.48 MWh

**Probability distribution**





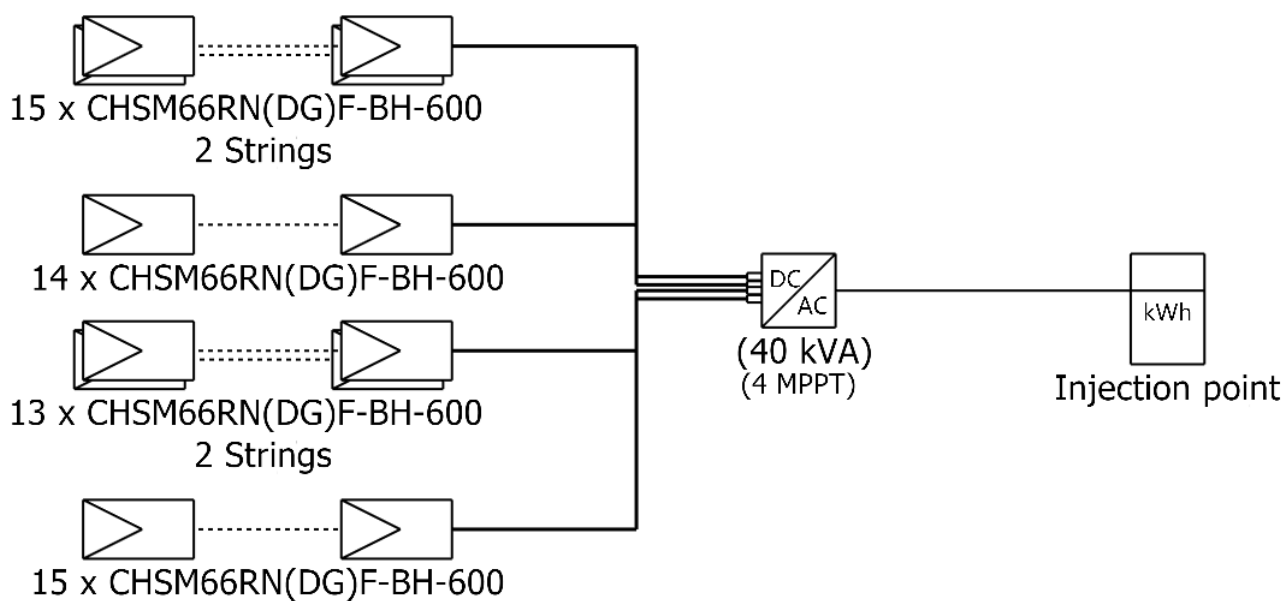
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# Single-line diagram



PV module	CHSM66RN(DG)F-BH-600
Inverter	SUN2000-40KTL-M3-400V
String 1	15 x CHSM66RN(DG)F-BH-600
String 2	14 x CHSM66RN(DG)F-BH-600
String 3	13 x CHSM66RN(DG)F-BH-600

Bank Albilad-Parking

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